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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

REPLY TO THE ATTENTION OF

SR-6J

APR 11 2019

Mr. Leo Brausch
Brausch Environmental, LLC
5318 Alexa Road
Charlotte, North Carolina 28277

Re: EPA Comments on Memorandum - Review and Assessment of Geologic Data on the Clay Confining Layer and Other Relevant Information
Remedial Investigation/Feasibility Study for Operable Unit 2
Lake Calumet Cluster Site, Chicago, Illinois

Dear Mr. Brausch:

The U.S. Environmental Protection Agency and the Illinois Environmental Protection Agency have reviewed the *Memorandum - Review and Assessment of Geological Data on the Clay Confining Layer and Other Relevant Information,* dated October 31, 2018 for the Lake Calumet Cluster Site (Site) in Chicago, Illinois. The Memorandum, prepared by Arcadis, on behalf of the Lake Calumet Cluster Site Group, was submitted as part of the Operable Unit 2 Remedial Investigation/Feasibility Study being conducted at the Site.

Enclosed are EPA comments on the above referenced document. If you have any questions regarding this letter, please contact me at (312) 886-6151 or by e-mail at kolak.shari@epa.gov.

Sincerely,

Shari Kolak

Shari Kolak
Remedial Project Manager
Superfund Division

Enclosure

cc: Nicole Wilson (IEPA)

EPA COMMENTS
MEMORANDUM: REVIEW AND ASSESSMENT OF GEOLOGIC DATA ON THE CLAY CONFINING LAYER AND OTHER RELEVANT INFORMATION DATED OCTOBER 31, 2018
LAKE CALUMET CLUSTER SITE, CHICAGO, ILLINOIS

I. General Comments

Comment 1: Summary and Introduction – The *Memorandum: Review and Assessment of Geologic Data on the Clay Confining Layer and Other Relevant Information at the Lake Calumet Cluster Site in Chicago, Illinois*, dated October 31, 2018 (Technical Memorandum) indicates series concerns by the Lake Calumet Cluster Site (LCCS or Site) Group; however, properly designed and installed deep wells pose little or no threat to the Silurian and other bedrock regional aquifer systems present beneath the Site. Such wells are necessary for understanding the hydrogeologic conditions at the Site that control the spread of contaminants to surrounding environs. Properly located and completed nested wells and surface water gauging stations are needed as described in more detail later in these comments to support the assessment of the clay confining layer as well as the OU2 groundwater and surface water sampling designs.

Comment 2: Summary and Introduction - Available geotechnical data for fine grained glacial drift materials from the Wadsworth Till in the northern Chicago area indicate the tills are primarily silty-clays with 50 percent or more silt and sand with moderate to low plasticity as opposed to clay. The plasticity is noted to depend on the grain size distribution[1]. The composition of the till beneath the Site needs to be analyzed for geotechnical and hydrologic properties before any conclusions can be drawn in terms of the storativity, transmissivity, and potential for contaminant seepage from fill through the glacial drift to the Silurian and other carbonaceous bedrock aquifers. More specifics concerning hydrogeologic and geotechnical tests suggested for performance are provided in the summary and conclusion comment at the end of this review.

[1] The following publications provide information concerning the geotechnical and physical properties of the Wadsworth Till referenced as being present beneath the Site in the Technical Memorandum. The data contradicts the presumption that the Wadsworth Till is highly plastic as suggested in the Introduction and Summary section of this Technical Memorandum. These references include the following:

A) *Particularity of Plasticity Characteristics of Fine Glacial Materials (North Chicago Area),* in Geo-Eco-Marina, July 2011. J. Constantinescu. See https://geoecomar.ro/website/publicatii/Nr.17-2011/07_constantinescu_BT.pdf

B) *Geology and Engineering Characteristics of Some Surface Materials in McHenry County, Illinois*, ISGS, January 1968. W. Calhoun Smith, in Environmental Geology Notes, Number 19. See https://www.ideals.illinois.edu/bitstream/handle/2142/78850/geologyengineeri19smit.pdf?sequence=1&isAllowed=y

C) *Chicago Underflow Plan, Phase II GDM, O'Hare Reservoir Phase II ..., Volume 1* Page C4-26. See https://books.google.com/books?id=Uyw0AQAAMAAJ&pg=RA5-PA26&lpg=RA5-PA26&dq=plasticity+of+the+wadsworth+till+chicago&source=bl&ots=ak4SsDXYo8&sig=ACfU3U241fKyrmo5RhoYPqVWtux1j7e8dQ&hl=en&sa=X&ved=2ahUKEwitzO7O_argAhUm0YMKHWdBBp8Q6AEwAHoECAUQAQ#v=onepage&q=plasticity%20of%20the%20wadsworth%20till%20chicago&f=false

Comment 3: Geologic Data Review, Bullet 1 - The use of Illinois State Geologic Survey (ISGS) regional scale mapping of "glacial drift" and scant deep borings to estimate the lateral and vertical extent of fine-grained sediments beneath the Site is inadequate. For example, the statement in this section that the ISGS study indicates glacial drift are generally 100 to 200 feet thick at the Site, is not properly caveated with other evidence of drift thickness, such as the United States Geologic Survey (USGS) *Characterization of Fill Deposits in the Calumet Region of Northwestern Indiana and Northeastern Illinois*, Kay, 1997, which show in Figure 7, a glacial drift thickness at the Site of 50-75 feet. As noted in the Geologic Data Review, Bullet 1 of this Technical Memorandum, the ISGS maps define the approximate extent of "glacial drift" across the State of Illinois. By definition, the deposits mapped by the ISGS as "glacial drift" include unconsolidated deposits, including glacial tills, outwash sands and gravel, and fine-grained stream and lake bed sediments. The ISGS makes no distinction between these differing lithologies that can have vastly different hydraulic conductivities. Regional mapping of the "glacial drift" unit by ISGS were likely performed through the use of aerial photographs and some limited boring log data, none of which, were from the Site.

Comment 4: Geologic Data Review Bullet 2 - It is well documented in the USGS studies, *Geohydrology, Water Levels and Directions of Flow, and Occurrence of Light-Nonaqueous-Phase Liquids on Ground Water in Northwestern Indiana and the Lake Calumet Area of Northeastern Illinois*, Kay 1996 and the *Use of Isotopes to Identify Sources of Ground Water, Estimate Ground-Water-Flow Rates, and Assess Aquifer Vulnerability in the Calumet Region of Northwestern Indiana and Northeastern Illinois,* Kay 2002, that mining and landfill excavation activities have impacted the thickness of the glacial drift unit. Localized reef structures in the underlying dolomitic aquifer materials have also created structural highs in the underlying bedrock that can reduce the thickness of the glacial drift to less than 10 feet. Weathering, root casts, and other physical heterogeneities can also impact the flux of water through the glacial drift. Weathering and localized increases in hydraulic conductivities are expected in the upper 30 feet of the "glacial drift" unit (Kay, 1996). Further, impacts because of weathering are evidenced on many of the Hydraulic Profiling Tool (HPT) average pressure logs provided in Appendix C of the *Technical Memorandum: Groundwater Assessment Lake Calumet Cluster Site, Operable Unit 2"* (Arcadis, July 2017).

Comment 5: Geologic Data Review, Bullet 2 - In this section of the Technical Memorandum, Arcadis concludes that the thickness of the glacial drift unit thickens to the south towards the Site as compared to the deep soil borings on the former Interlake site located north of the Site. Presumably, this conclusion is based on the regional mapping performed by the ISGS. This conclusion is contrary to the existing data from the deep boring immediately north of the Site drilled on Paxton 1 Landfill and the deep boring shown in Figure 3, Geologic Cross Section A-A' North to South, located on the northwest corner of the Site. The reason for the thinning of the glacial drift near and on the Site is unknown, but it could be the result of mining or landfill excavation.

Also, Figure 3 clearly depicts the fact that based on existing data, the glacial drift unit is no more than 57 feet thick beneath the northwest corner of the Site. Because increased weathering in the top 30 feet of the till has been noted by Kay 1996 and is evidenced in HPT logs, the till may or may not be adequate to protect the underlying Silurian and other carbonate regional aquifers present beneath the Site.

Comment 6: Geologic Data Review, Bullet 3 – As noted by many authors and summarized well by Constantinescu (See Comment 1, footnote 1), *2011 "Glacially derived deposits are among the most complicated of all geological environments, due to the fact that the motion of ice mixed together a large variety of materials. In general, the glacial materials have an overall appearance similar to the regular sedimentary materials, and are even labeled with the same terminology used for sedimentary deposits: gravel, and, silt, clay, etc. However, it is important to note from the beginning that the genetic mechanism imposed by movement of solid ice has little to no correlation to genetics processes of water-based erosion, transport and deposition."* For this reason and considering observations discussed above by Kay 1996, the USGS 2002, and ISGS 1968, it is not appropriate for Arcadis to imply in Section 3 of the Geologic Data Review that *"The native clay confining unit encountered at the Site is a uniform, high-plasticity clay with no evidence of fractures or higher permeability seams present within the unit."* The glacial drift and related tills beneath the Site are part of complex lithologic units as indicated by the range hydraulic conductivities reported from well tests in the general area of the Site reported by Kay (1996) and discussed in this section.

Comment 7: Geologic Data Review, Bullet 3 – In this section, a range in horizontal hydraulic conductivity values for the Wadsworth Till from Kay (1996) are presented; however, the horizontal hydraulic conductivity values reported by Kay (1996) were collected from slug tests performed in wells from weathered and unweathered portions of the glacial drift unit. Values were compiled from other studies conducted on other sites in the same general area, but not from the Site. As anticipated the range of hydraulic conductivity values reported for the glacial drift are broad as is the degree of weathering and compositional variations in the glacial drift deposit. The reported horizontal hydraulic conductivity values reported discussed by Kay (1996) range from 1.7×10^{-5} feet per day (ft/d) to 5.5×10^{-1} ft/d (6.0×10^{-9} centimeters per second [cm/s] to 1.8×10^{-4} cm/s). Slug tests were performed in 24 wells completed in the weathered zone in the drift and 18 wells completed in unweathered till zones. The median horizontal hydraulic conductivities reported by Kay (1996) of the weathered part of the confining unit were calculated to be 5.8×10^{-2} ft/d (2.0×10^{-5} cm/sec), whereas the median value for the unweathered part of the confining unit were calculated to be 2.8×10^{-3} ft/d (9.9×10^{-7} cm/sec). Permeameter tests at three sites near Lake Calumet and two sites in Gary indicate a range of vertical hydraulic conductivities in the glacial drift were from 3.7×10^{-6} to 1.6×10^{-3} ft/d (1.3×10^{-9} to 5.6×10^{-7} cm/sec).

Comparing these results to information provided for general lithologic types in Freeze and Cherry (1979) and Fetter (2001) the range in reported horizontal conductivity values for the glacial drift range from those of a silty sand down to silty clays, and clays (e.g., 1.0×10^{-4} to 1.0×10^{-9} cm/sec). Vertical conductivities are generally greater than horizontal conductivities, as noted by Kay (1996), in the Wadsworth glacial drift. However, permeameter data from near the Site and Gary Indiana suggest that vertical conductivities could be lower than is suggested by the horizontal conductivity results. Regardless, the potential for water to pass through the glacial drift beneath the Site could be highly variable.

As noted in Comment 1, the glacial drift is expected to have moderate to low plasticity depending on the grain size distribution. Therefore, Site specific permeameter and slug test data are needed to evaluate the effectiveness of the glacial drift to protect the Silurian and other bedrock aquifers. This is particularly true, considering the thickness of the glacial drift beneath the Site is 57 feet, and could be less, if impacted by excavation. In addition, weathering may have impacted the upper 30 feet of the till making the undisturbed portion of the drift less than 30 feet thick.

In the State of Ohio (2009) aquitard guidance, 30 feet of a good aquitard material, such as a marine shale, with conductivities of less than 10^{-9} cm/sec are generally considered as a minimum thickness before protection can be demonstrated to be adequate. Given the conductivities expected in the glacial drift, it is anticipated that a much thicker section of tight till will be required to provide adequate protection to the underlying Silurian and other bedrock aquifers.

Comment 8: Tunnel and Reservoir Plan (TARP) System and Impacts to Bedrock Groundwater – The periodic changes to the hydrogeologic system near the Site as a result of the Tunnel and Reservoir Plan (TARP) system during periods of wet weather need to be considered when planning sampling activities and well development at the Site. During dry periods groundwater gradients may become increasing strong and downward in the shallower groundwater systems due to the water table drop in the Silurian bedrock aquifer noted in this Section. The lowering of the Silurian aquifer during dry periods may increase infiltration rates from the Site to the Silurian bedrock aquifer. Head drops in the Silurian bedrock as a result of the TARP system are generally consistent except during periods of precipitation. Also, the Technical Memorandum indicates the groundwater chemistry is affected by the TARP; however, documented releases from the TARP and constituent data from the TARP are not provided to support this assertion. It is unlikely that contaminants from TARP will overlap with organic contaminants expected to be present at the Site. Analyzing for fecal coliform would eliminate any questions concerning the potential influence of the TARP system.

II. Summary and Concluding Comments

Comment 9: Site specific information is needed to confirm many aspects of the aquitard beneath the Site before it can be considered as available portion of any groundwater protection remedy. Relevant information needs to be compiled and analyzed as the basis for the development of any groundwater or surface water sampling designs. Based on the site-specific data gaps present at the Site the following types of data may be needed, at a minimum, to verify the potential for the glacial drift beneath the Site to be confirmed as a protective aquitard.

1) Mapping of the top of the glacial drift and bedrock using geophysical methods. The data can be used to identify preferred pathways for groundwater. Geophysical data can also be used to identify localized topographic highs in the bedrock and the depth of excavation into the glacial drift. Both factors can result in a thinning of the aquitard beneath the Site. Geophysical methods may also be a viable options for estimating the thickness of the glacial drift across the Site.
2) Installation of nested wells completed near the water table, in the weathered top and lower unweathered portions of the glacial drift, and in the Silurian bedrock aquifer at the dry period water table.

3) Electrical well logging.
4) Physical properties testing of the glacial drift beneath the Site, including multiple vertical intervals to assess physical properties within the entire vertical profile of the glacial drift. Geotechnical tests should include but not be limited to grain size analysis, liquid limit, plasticity limit/Atterberg limit, X-ray diffraction tests for clay mineralogy, permeability, and porosity.
5) Surface water and groundwater elevation measurements to evaluate groundwater and surface water flow directions and gradients.
6) Hydrogeologic testing including vertical conductivity testing in the glacial drift using a permeameter and horizontal conductivity testing using slug and or pump testing of select open intervals in the nested wells.
7) Sampling and analysis of groundwater for a full list of contaminants potentially present on the Site.
8) Evaluation of the use of isotopic age dating and tracers methods for predicting groundwater and surface water interactions.

The following list of guidance documents may be helpful in evaluating the viability of the glacial drift under the Site to act as a protective aquitard.

1) *Contaminant Transport Through Aquitards: Technical Guidance for Aquitard Assessment* Prepared by the American Water Well Association (AWWA) by Bradbury et al., (2006). See http://www.waterrf.org/Pages/Projects.aspx?PID=2780

2) *Contaminant Transport Through Aquitards: A State-of-the-Science Review and Technical Guidance for Aquitard Assessment* Prepared by the American Water Well Association (AWWA) by Bradbury et al., (2006). See http://www.waterrf.org/Pages/Projects.aspx?PID=2780

3) *Management of Contaminants Stored in Low Permeability Zones.* ER-1740 State of the Science Review Report, SERDP, 2013. See https://www.serdp-estcp.org/Program-Areas/Environmental-Restoration/Contaminated-Groundwater/Persistent-Contamination/ER-1740/ER-1740-TR

4) *Aquitard Characterization.* March 2014. State of Indiana Guidance. See https://www.in.gov/idem/cleanups/files/remediation_tech_guidance_aquitard_characterization.pdf

5) *Assessment of an Aquitard during Ground Water Contamination Investigation,* November 2009. See https://www.epa.ohio.gov/Portals/28/documents/TGM-Supp1.pdf

6) *Role of Aquitards in the Protection of Aquifers from Contamination: A State-of-the-Science Report,* 2004. See https://clu-in.org/download/contaminantfocus/dnapl/Chemistry_and_Behavior/Aquitard_State_of_Science_Reportfor_AWWARF_draft_of1-3-05.pdf